

SECTION SEVEN TEACHING/LEARNING MEASUREMENT

General Overview

The development of skills in measurement is essential in life. Measurement connects mathematics to the environment and it also facilitates the integration of other strands of the primary mathematics curriculum. Measurement provides an excellent opportunity to link basic measurement concepts to number concepts. In addition, the teaching of measurement offers opportunities for integrating learning in subjects such as science, industrial arts, art, social studies, home economics and music. The ability to use measuring tools such as rulers, tape measures, thermometers, measuring cups and scales is a necessary competence for students to develop. Estimation is also a critical aspect in the development of measurement skills. For example, students should be able to say that a breadfruit weighs about 1 kilogram before they actually put it on a scale to measure it.

The aims of teaching measurement at the primary level are to assist students to:

- § *Make comparisons between objects by matching.*
Students compare objects by matching, without the use of tools of measurement. They order things by the method of comparison; e.g., taller than, the same as, shorter than.
- § *Compare objects with non-standard units.*
Students use a variety of objects for measuring-parts of the body, straws, cubes, books and whatever else is readily available.
- § *Compare objects with standard units.*
Students develop an understanding of standard units as a convenient extension of non standard units, useful for the purpose of communication.
- § *Choose suitable units for specific measurements.*
Students learn to select the appropriate standard units of measurement needed for specific applications.

The measurement attributes to be considered are: length, time, mass, capacity, temperature and area. The measurement of quantity using money is also included.

In teaching measurement, you should focus on developing a procedural and conceptual understanding of measurement. The procedural element of measurement relates to the process of measuring, that is, how to measure. The conceptual element focuses on what it means to measure. It must be noted that in carrying out measurement, primary school students have difficulties in both aspects of measurement. To overcome these difficulties, clearly defined procedures for how to measure and what it means to measure should be developed. Table 3 outlines how these aspects of measurement might be considered in the teaching of measurement.

Table 3. Integrating the elements of measurement

Procedural	Conceptual	Types of activities
Decide on the attribute to be measured.	Understand the attribute being measured	Make comparisons based on that attribute
Select a unit that has that attribute.	Understand how filling or covering an attribute with units produces measure.	Use physical models of measuring units to actually fill or cover the attribute.
Compare the attribute being measured to the unit by filling or covering the attribute with units.	Understand the way that measuring instruments work.	Make measuring instruments and use along with unit models.

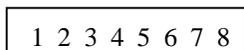
Table 3 indicates that the measurement process consists of the following steps:

1. Identifying the attribute to be measured.
2. Selecting an appropriate unit
3. Comparing the object/attribute to the unit.
4. Finding the number of units by counting, using instruments, or formulas.
5. Recording the number of units.

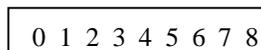
The ability to perform these steps depends on an understanding of the notions of attribute and unit as well as an awareness of how to use instruments.

Things to note about measurement

1. All measurements are approximate.
2. In measuring length, the characteristics of the instrument – a ruler- must be taken into account, that is whether it is ‘dead-end’ or ‘waste-end’. With a ‘dead-end’ ruler, counting of the units starts from the very edge of the ruler. With a ‘waste-end’ ruler, the starting points of the units are not at the edge of the ruler. Students will need to learn how to align both types of rulers to the object being measured.

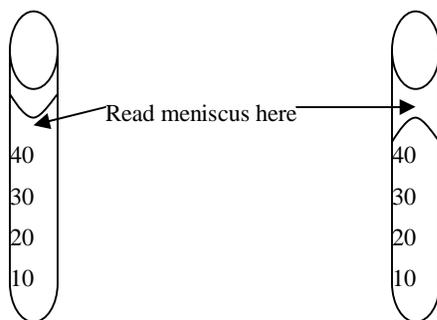


‘Dead-end’ ruler



‘waste-end’ ruler

3. In measuring time on an analog clock, students should understand:
 - § What each hand indicates
 - § What the approximate position of the hands indicates.
4. Weight and mass are not synonymous. Mass is constant while weight may vary depending on the gravitational pull.
5. Capacity and volume are not synonymous. Capacity is the measure of the amount something can hold. Volume is the amount of space an object occupies.
6. Students must be aware of the correct way to read the meniscus on the thermometer when measuring temperature. The meniscus must be held at eye level.



7. The structure of the metric system, like our numeration system, is based on powers of ten. Units of length are multiples or submultiples of the metre. These multiples or sub-multiples are powers of ten. The names for the units use a system of prefixes that are related to the multiples of ten. Note that symbols are lowercase letters and are not followed by periods. These same prefixes are used with the litre (l) and the gram to create units for capacity and mass. However, only a few of the resulting units are used in everyday life (see Table 4). Units for area are derived from the units for length. A square metre (m^2) is a square of side one metre.

Table 4. SI units of measurement in common use

Length	Mass	Capacity	area
Millimetre	milligram	millilitre	Square millimetre
centimetre			Square centimetre
metre	gram	litre	Square metre
kilometre	kilogram		Square kilometre

A major advantage of the metric system is that the units for volume, capacity, and mass are related in a simple way. A cubic decimetre is a litre of water, for example and that volume of water (at $4^{\circ}C$) has a mass of one kilogram.

The basic unit for measuring time is the second (s). The minute (min), hour (hr) and day are also used. Temperature is reported in degrees Celsius. The standard unit for measuring angles is also called the degree.

Relationships among metric units can often be discovered directly. For example, it takes 10 centimetres to make an object 1 decimetre long. To successfully convert from one unit to another, the student needs to know the meaning of the prefixes, be able to multiply and divide by powers of 10 and understand that the larger unit will be associated with a smaller number.

Definitions

- Capacity -- The amount of substance a container can hold.
- Length -- The horizontal or vertical distance between two points on an object.
- Mass -- The amount of matter an object can hold.
- Temperature -- The measure of how hot or cold an object is.
- Time -- Time can be explained in terms of the earth's movement relative to other celestial bodies. However, in mathematics, we are more concerned with the use of instruments to record:
- § the instant when an event occurs
 - § the duration of an event.
- Volume -- The space an object occupies.
- Weight -- How heavy or light an object is.

General principles related to teaching/learning measurement

The process, concepts and instructional sequence for each measurement topic are basically the same even though the meanings, units, and formulas associated with the various attributes are different.

First, the meaning of the attribute is developed through activities involving perception and direct comparison. Second, students begin to measure using arbitrary or non-standard units. Third, they measure and estimate using standard (SI) units. Related experiences involve learning to use instruments and read scales. There is also attention to the development and use of formulas to determine measurements.

Perception and direct comparison are pre-measurement processes. They do not require a unit, nor do they involve the assignment of a number to the object being measured. These processes result in descriptions of comparison, for example, longer than. Activities associated with these processes should allow students to experience the properties of the attribute and to use sight and touch to compare and order objects with respect to their characteristics. The use of appropriate language in direct comparison tasks is critical to enabling students to relate the concept to their experience and to distinguish among the various attributes.

At the measurement phase, the question is: ‘How Big?’ rather than ‘which is bigger?’ This leads to the question: ‘Compared to what?’” The first criterion for selecting an appropriate unit is that it has the same attribute as that to be measured. Thus a long thin object such as a pencil would be a good unit for measuring length but it would not be good for measuring angles. Another consideration is the size of the unit relative to the object to be measured. The unit should usually be smaller than the object but large enough so that the counting can be completed in a reasonable time.

As students gain experience in using standard units they should be encouraged to estimate their answers before they measure. They should be challenged to predict the effect of using a larger or smaller unit.

In the earlier grades, several common metric units such as the metre, the litre, and the kilogram were introduced. In Grades 5 - 6, the students will refine their understanding of these units and the relationships that exist among the units of measurement in the metric system. As well, it is expected that the students will master the measurement the various attributes of objects using these units. Given that within the Organisation of Eastern Caribbean States, imperial units are still being used, outcomes related to the more common imperial units in use have been included in the Grade 5 -6 curriculum. Thus, the students will explore when and how these units are used and make rough comparisons between the imperial units and related metric units. Note that in making these comparisons, the emphasis will be on estimating and enabling the students to function in real life rather than on making direct conversions from one system to another.

Specific Activities –Grade Six

Outcome 1, 7

Students should be able to:

Select the most appropriate unit to estimate and measure a length, the mass, or the capacity of a given object and give reasons for their choice of unit.

Estimate and measure the lengths and heights of objects using the metre, centimetre, and/or millimetre as the units of measure.

Materials: A selection of classroom and household objects; instruments for measuring length, mass, and capacity.

Activities: Provide the students with a selection of objects.

Place the measuring instruments on a desk at the front of the class.

Describe the activity to the students. They are to estimate and measure the length and mass of each object, using the most appropriate instrument and unit. Let them record their results in a table such as the following.

The activity may be modified for the measurement of capacity.

Object	Most Appropriate unit of measurement	Estimate	Measurement	Reasons for choice s

Outcome 3

Students should be able to:

Explain how to use instruments for measuring length, mass, capacity, and time.

Materials: A selection of measurement instruments; charts/pictures depicting persons using various measurement instruments.

Activities: Place a selection of measurement instruments.

Call on individual students to select an instrument and state the attribute it is used to measure. For example, they may state that the ruler is used to measure length. Let the student go on to explain and demonstrate how the instrument is used.

Let the students work in groups. Distribute the pictures/charts among the groups. Ask the students to look at each chart or picture and decide if the measuring instrument(s) is/are being used appropriately.

The students then report their decision to the class and give reasons for their decisions.

Outcome 7

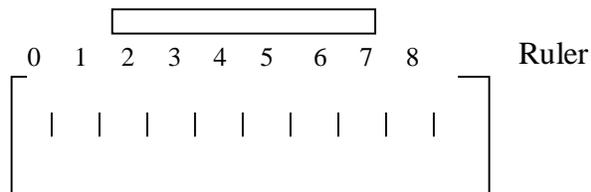
Students should be able to:

Estimate and measure the length and height of objects using the metre, centimetre, and/or millimetre

Materials: Diagrams of measurement situations.

Activity: Show the students a diagram such as the following.

:



Ask the students to read off the length of the object and record it. Indicate the correct measurement. Let the give reasons why their measurement was correct or incorrect.

Guide them to explain the correct procedure for measuring lengths and heights.

Let them measure the lengths and heights of various objects.